PET ASCII OUTPUT PROGRAM

By Charles F. Milazzo, KP4MD
USNS Box 3007
FPO Miami, FL 34051-8150

INTRODUCTION

This article describes a project which may be useful for anyone desiring to use software for the ZX81, TS1000 or TS1500 on a different computer. The program version presented here is designed to convert Sinclair BASIC programs into ASCII text which can be sent from the Sinclair computer to the serial port of a Commodore computer. The program can be used with other computers if the non-standard graphic characters are eliminated or appropriately changed. In addition to the program described here, the user will require a terminal program that permits the receiving computer to download and save text, e.g., Plus/Term in Feb. 1985 Compute!, and a very simple hardware circuit to interface the computers.

The program described here consists of a portion in BASIC which is used to set the parameters and to relocate the 327 byte machine language (ML) program which is in the first REM statement. Typically, 327 bytes can be reserved above RAMTOP by lowering it to 32441 (in 16K machines) with the following sequence: POKE 16388,185; POKE 16389,126; NEW; then LOAD "PET ASCII".

THE BASIC PROGRAM

Upon running the BASIC program the prompt "RELOCATE?" will appear. Enter "N" or ENTER alone if you desire to run the ML program at its original location in the REM statement. The response "Y" will cause the computer to request "NEW LOCATION=" which should be answered with 32441 in this example. Lines 110-140 copy the ML program to the new location and lines 150-220 make the required adjustments to the addresses in the ML code. The computer will print "OUTSCREEN = RAND USR 32568, OUTPROG = PRINT USR 32685". This information should be noted as these are the commands required to send a display screen or a BASIC program as ASCII text. The computer then requests "BAUD RATE?" which can be selected up to 2400 baud. The "STOP BITS?" requests the number of stop bits between characters. By experience, one stop bit is usually sufficient for data speeds up to 1200 baud. At least 2 stops bits should be used for higher speeds. In lines 290-400 the program calculates the required constants and POKEs them into the appropriate locations. (The variable F in line 310 is set to the computer's clock frequency, nominally 3.25 MHz. Variable G in line 320 represents fixed number of clock cycles in the bit length delay loop. The "+10" represents the duration of the ML commands at 40D3h and 40D4h which only exist to allow a very fine adjustment in bit duration). "PRESS ENTER TO TRANSFER PROGRAM" is displayed and pressing enter will activate the ML routine. After the original BASIC program is NEWed any desired BASIC program can be LOADed and transferred to a receiving computer by ENTERing PRINT USR 32685 since the ML program is protected from the NEW command.

THE MACHINE LANGUAGE PROGRAM

The entry point for program transmission is at label OUTPROG (4176h). The addresses referred to here correspond to the original location of the ML program in the REM statement. The computer is placed in FAST mode and a 10 second silence follows. If required, the receiving computer's text buffer should be opened in this time. The text byte counter (407Bh) is zeroed and the beginning address of the program is stored at 403Ch. A CONTROL Q is transmitted to signal beginning of transmission. At label NEWSCREEN (4196h) the screen is cleared. A check for the BREAK key is made and a check is made to see if the end of the program has been reached. If either of these conditions is true then a jump to EXIT (41C4h) is made, a CONTROL C is sent signalling end of transmission and a return to BASIC is made with the text byte counter value in the BC register pair. Otherwise, the successive program lines are printed to the screen and transmitted by a call to the OUTSCREEN subroutine. The routine will stop and display any line exceeding the 704 character screen size. Such lines should be deleted to enable OUTPROG to transfer the program. The CONTROL characters are sent in case the receiving terminal program requires them for text loading. They may be changed as needed by poking the required values at 4192h and 41C5h.

The OUTSCREEN subroutine transmits text printed on the screen up to the display file character counter (DF-CC) which is used as an end marker. At 4101h the blank spaces after the last screen line are eliminated by adjusting DF-CC to address after the last printed character. The screen contents are then scanned and converted at OUTCHAR to PET ASCII characters and graphic symbols with any appropriate RVS ON and RVS OFF characters. When the last screen character is sent, a jump is made to OUTCR which sends a carriage return and exits the subroutine.

The OUTBYTE subroutine (40D8h) sends each byte loaded into the E register out through the computer's TV/TAPE port. Each bit is rotated through the carry bit and the appropriate MARK or SPACE subroutine is called. The text byte counter is incremented before exiting the outbyte subroutine.

TRANSFERRING VARIABLES AND GRAPHIC DISPLAYS AND NON-ASCII TEXT

After transferring a program, any arrays or other values in the variable area may also be transferred by printing them as BASIC statements and using RAND USR OUTSCREEN. E.g., a 100 element numerical array A(100) can be sent by entering the following lines and executing GOTO1:

```
1 FAST
2 FOR I=1 TO 2000
3 NEXT I
4 LET OUTSCREEN=32568  (ML above 32441)
5 LET AD=9000
6 GOSUB 21
7 PRINT " DIM A(100):FOR I=1 TO 100:READ A:NEXT I"
8 GOSUB 18
9 FOR I=0 TO 95 STEP 5
10 PRINT " DATA ";
11 FOR J=1 TO 5
```

```
12 PRINT A(I+J);
13 IF J<5 THEN PRINT ",";
14 NEXT J
15 GOSUB 18
16 NEXT I
17 STOP
18 RAND USR OUTSCREEN
19 LET AD=AD+10
20 CLS
21 PRINT AD;
22 RETURN
```

Graphic displays can also be sent using the OUTSCREEN subroutine. OUTSCREEN usually ignores the NEWLINE characters at the end of each display line, but for sending graphic displays these should be sent as carriage returns by poking 00 at 412Fh. Displays produced with AT commands may set DF-CC before the end of the screen text causing OUTSCREEN to send only part of the screen. This can be corrected by inserting a PRINT AT 21,31 command before the RAND USR OUTSCREEN in the program.

Non-ASCII text, e.g., machine language files can be transmitted using the OUTCR subroutine. Each text byte must be poked into 40D7h followed by executing RAND USR OUTCR as below:

```
1 FAST
2 FOR I=1 TO 2000
3 NEXT I
4 LET OUTCR=32525        (ML above 32441)
5 FOR I=32441 TO 32767   (Send PET ASCII ML Program)
6 POKE OUTCR+1,PEEK I
7 RAND USR OUTCR
8 NEXT I
```

THE INTERFACE

The hardware interface is shown in the accompanying schematic diagram and consists of the following components:

PART	RADIO SHACK #	DESCRIPTION
D1	276-1122	1N914 type diode
Q1, Q2	276-2009	NPN silicon transistors 2N2222 or equiv.
R1	271-010	68 ohm 1/2 watt resistor
SO1	DIGIKEY# C1-12	24 contact edgeboard connector
	DIGIKEY# CR1164-1	2 polarizing keys for above connector

Point A is connected to the TV/TAPE output of the computer logic chip. In the ZX81/TS1000 this is pin 16 of IC1, connected to the junction of D9 and R29. In the TS1500 this is pin 53 of U5, connected to the junction of D19 and R20. Point B is connected to +5 volts and point C is connected to the ground foil. In the interface circuit, D1 is used to protect the computer logic chip in case of failure of Q1. Q1 is connected as an emitter follower identical to the common video output modification for the Sinclair computers. Q2 converts the output of Q1 to the proper on-off switching required by the Commodore user

port. The edgeboard connector is used to connect the interface to the Commodore 64 user port. Point D is connected to pins B and C of the user port and point E is connected to pin A.

OPERATION

In typical operation, the receiving computer is connected and set to the desired data speed and 8 bit word length. The Sinclair ML program is set up as described above RAMTOP or in CMOS RAM, EPROM or other available memory. The desired BASIC program is loaded into the Sinclair computer in the usual manner. The command PRINT USR [OUTPROG address] is executed and the text buffer of the receiving computer is opened. The ASCII data transmission is seen as varying horizontal bars on the monitor screen. The transmission may be aborted at any time by pressing and holding the BREAK key.

After any text transmission is terminated, the number of bytes sent is displayed in the upper left hand corner of the screen. The text buffer in the receiving computer should be closed and saved to tape or disk. This ASCII file must be converted into BASIC tokens. The PLUS/TERM program described above has a utility program called "TOKENIZER" which performs this task for users with disk drives. Another utility program called "RECRUNCHER" appeared in July 1985 Compute! and works with tape or disk drive. Sinclair BASIC programs will rarely run on other computers without some translation of commands. Translation can be done line by line or with the aid of a utility program such as "METABASIC" in April 1985 Compute Gazette.

CONCLUSION

This project is a worthwhile investment and has saved the author the hundreds of thousands of keystrokes that the transfer of an extensive collection of programs would have required. The author would appreciate any suggestions for improvements or other feedback from users. The author can supply this program for anyone who prefers it on cassette. The amount of $5 is requested for the tape and postage.

```
0 REM...(327 BYTES FOR ML)...
10 REM PET ASCII OUTPUT PROGRAM BY CHARLES F. MILAZZO
20 PRINT "RELOCATE?"
30 INPUT A$
40 CLS
50 LET ORG=16514
60 LET DIS=0
70 IF A$<"Y" THEN GOTO230
80 PRINT "NEW LOCATION=";
90 INPUT LOC
100 PRINT LOC
110 LET DIS=LOC-ORG
120 FOR I=ORG TO ORG+326
130 POKE I+DIS,PEEK I
140 NEXT I
150 LET A$="166011661416619166261668416726167381674816753167881683216839"
160 FOR I=1 TO 56 STEP 5
170 LET A=VAL A$(I TO I+4)
180 LET AD=PEEK A+256*PEEK (A+1)+DIS
190 LET H=INT (AD/256)
200 POKE A+DIS+1,H
210 POKE A+DIS,AD-256*H
220 NEXT I
230 LET BH=16587+DIS
240 LET BL=16588+DIS
250 LET SB=16624+DIS
260 LET OS=16641+DIS
270 LET OP=16758+DIS
280 PRINT "OUTSCREEN = RAND USR ";OS,"OUTPROG = PRINT USR ";OP
290 PRINT "BAUD RATE? ";
300 INPUT R
310 LET F=3.25E6
320 LET G=93+10
330 LET M=INT (F/R+.5)
340 LET C=INT ((M-G+3310)/3339)
350 LET B=(M-G-3339*C+3323)/13
360 POKE BH,C
370 POKE BL,INT B
380 PRINT R,,"STOP BITS? ";
390 INPUT S
400 POKE SB,S
410 PRINT S,,"PRESS ENTER TO TRANSFER PROGRAM"
420 INPUT A$
430 PRINT USR OP
440 PRINT "BYTES"
450 PRINT
460 GOTO290
470 SAVE "PET ASCI"
480 RUN
```

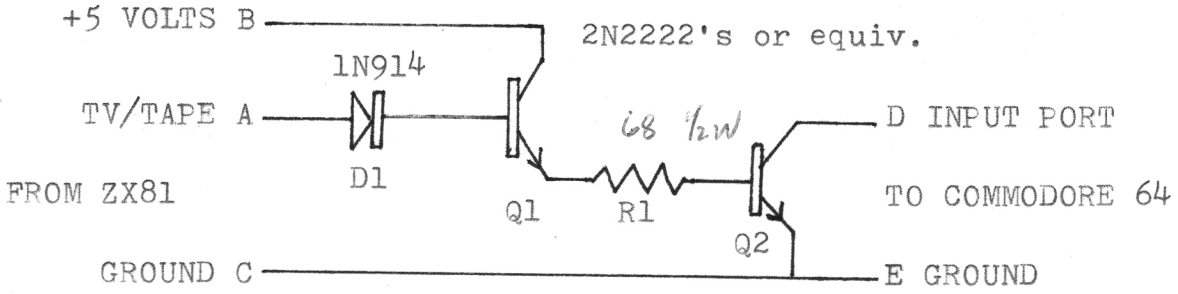
```
PET ASCII OUTPUT PROGRAM FOR ZX81 BY CHARLES F. MILAZZO

TABLE     4082 20 BE BC A2 BB A1 BF AC A6 A8 A2 22 5C 24 3A 3F
          4092 28 29 3E 3C 3D 2B 2D 2A 2F 3B 2C 2E 30 31 32 33
          40A2 34 35 36 37 38 39 41 42 43 44 45 46 47 48 49 4A
          40B2 4B 4C 4D 4E 4F 50 51 52 53 54 55 56 57 58 59 5A
MARK      40C2 DBFE      IN A,(FE)
          40C4 1804      JR DELAY
SPACE     40C6 D3FF      OUT (FF),A
          40C8 1800      JR DELAY
DELAY     40CA 01015F    LD BC,5F01       (2400 BAUD RATE CONSTANT)
LOOP      40CD 10FE      DJNZ LOOP
          40CF 0D        DEC C
          40D0 20FB      JRNZ LOOP
          40D2 AF        XOR A
          40D3 C0        RET NZ
          40D4 C0        RET NZ
          40D5 C9        RET
OUTCR     40D6 1E0D      LD E,0D          (SEND CR)
OUTBYTE   *40D8 CDC640   CALL SPACE       (START BIT)
          40DB 00        NOP
          40DC 00        NOP
          40DD 37        SCF
NEXTBIT   40DE CB1B      RR E             (FETCH EACH DATA BIT)
          40E0 280D      JRZ STOP
          40E2 3006      JRNC SP
          40E4 D0        RET NC
          *40E5 CDC240   CALL MARK
          40E8 18F4      JR NEXTBIT
SP        *40EA CDC640   CALL SPACE
          40ED 18EF      JR NEXTBIT
STOP      40EF 1E02      LD E,02          (# OF STOP BITS)
STOPBIT   *40F1 CDC240   CALL MARK
          40F4 1D        DEC E
          40F5 20FA      JRNZ STOPBIT
          40F7 ED4B7B40  LD BC,(407B)
          40FB 03        INC BC           (INCREMENT BYTE COUNTER)
          40FC ED437B40  LD (407B),BC
          4100 C9        RET
OUTSCREEN 4101 2A0E40    LD HL,(DF-CC)
          4104 AF        XOR A
COLLAPSE  4105 2B        DEC HL           (COLLAPSE LAST SCREEN LINE)
          4106 BE        CP (HL)
          4107 28FC      JRZ COLLAPSE
          4109 CB76      BIT 6,(HL)
          410B 20F8      JRNZ COLLAPSE
          410D 23        INC HL
          410E 220E40    LD (DF-CC),HL
OUTSCR2   4111 1600      LD D,00          (RVS FLAG OFF)
          4113 2A0C40    LD HL,(D-FILE)
NEXTCHAR  4116 23        INC HL
          4117 E5        PUSH HL
          4118 ED4B0E40  LD BC,(DF-CC)    (CHECK FOR END OF SCREEN)
```

```
            411C A7         AND A
            411D ED42       SBC HL,BC
            411F 7C         LD A,H
            4120 B5         OR L
            4121 E1         POP HL
            4122 28BB       JRZ OUTCR           (RETURN IF END)
            4124 7E         LD A,(HL)           (FETCH A CHARACTER)
            4125 FE76       CP 76
            4127 2007       JRNZ OUTCHAR
            4129 18EB       JR NEXTCHAR         (1800 TO SEND CR AFTER EACH LINE)
ENDLINE    *412B CDD640     CALL OUTCR
            412E 18E6       JR NEXTCHAR
OUTCHAR     4130 07         RLCA
            4131 FE16       CP 16               (DETERMINE INVERSE GRAPHICS)
            4133 3016       JRNC NORM
            4135 FE06       CP 06
            4137 3812       JRC NORM
            4139 FE08       CP 08
            413B 380C       JRC INV
            413D FE0C       CP 0C
            413F 380A       JRC NORM
            4141 FE12       CP 12
            4143 3804       JRC INV
            4145 FE14       CP 14
            4147 3802       JRC NORM
INV         4149 EE01       XOR 01
NORM        414B CB3F       SRL A
            414D F5         PUSH AF
            414E 300C       JRNC RVS-OFF
RVS-ON      4150 15         DEC D
            4151 2805       JRZ SET-D
            4153 1E12       LD E,12             (SEND RVS-ON)
           *4155 CDD840     CALL OUTBYTE
SET-D       4158 1601       LD D,01
            415A 180A       JR CONT
RVS-OFF     415C 15         DEC D
            415D 2005       JRNZ RESET-D
            415F 1E92       LD E,92             (SEND RVS-OFF)
           *4161 CDD840     CALL OUTBYTE
RESET-D     4164 1600       LD D,00
CONT        4166 F1         POP AF
            4167 E5         PUSH HL
            4168 0600       LD B,00             (TRANSLATE ZX81 TO PET ASCII)
            416A 4F         LD C,A
           *416B 218240     LD HL,TABLE
            416E 09         ADD HL,BC
            416F 5E         LD E,(HL)
           *4170 CDD840     CALL OUTBYTE        (SEND CHARACTER)
            4173 E1         POP HL
            4174 18A0       JR NEXTCHAR
OUTPROG     4176 CDE702     CALL FAST
            4179 210024     LD HL,2400
DELAY1      417C CD460F     CALL BREAK-1        (CHECK FOR BREAK KEY)
```

```
           417F D0        RET NC           (EXIT IF BREAK PRESSED)
DELAY2     4180 10FE      DJNZ DELAY2
           4182 48        LD C,B
           4183 2B        DEC HL
           4184 7C        LD A,H
           4185 B5        OR L
           4186 20F4      JRNZ DELAY1
           4188 227B40    LD (407B),HL     (ZERO BYTE COUNTER)
           418B 217D40    LD HL,PROGRAM    (START OF PROGRAM)
           418E 22EC40    LD (403C),HL
           4191 1E11      LD E,11          (SEND CONTROL Q)
          *4193 CDD840    CALL OUTBYTE
NEWSCREEN  4196 CD2A0A    CALL CLS         (CLEAR SCREEN)
           4199 CD460F    CALL BREAK-1     (CHECK BREAK KEY)
           419C 3026      JRNC EXIT        (EXIT IF PRESSED)
           419E 2A3C40    LD HL,(403C)     (CHECK FOR END OF PROGRAM)
           41A1 ED4B0C40  LD BC,(D-FILE)
           41A5 A7        AND A
           41A6 ED42      SBC HL,BC
           41A8 7C        LD A,H
           41A9 B5        OR L
           41AA 2818      JRZ EXIT
           41AC 2A3C40    LD HL,(403C)
           41AF CD4507    CALL PRLINE      (PRINT NEXT BASIC LINE)
           41B2 2A3C40    LD HL,(403C)
           41B5 23        INC HL
           41B6 23        INC HL
           41B7 4E        LD C,(HL)
           41B8 23        INC HL
           41B9 46        LD B,(HL)
           41BA 23        INC HL
           41BB 09        ADD HL,BC
           41BC 223C40    LD (403C),HL     (STORE ADDRESS OF NEXT LINE)
          *41BF CD0141    CALL OUTSCREEN   (SEND SCREEN)
           41C2 18D2      JR NEWSCREEN
EXIT       41C4 1E03      LD E,03          (SEND CONTROL C)
          *41C6 C3D840    JP OUTBYTE
```

* THESE INSTRUCTIONS REQUIRE OFFSET CALCULATIONS WHEN RELOCATED

FIGURE 1



HARDWARE INTERFACE FOR ASCII OUTPUT PROGRAM

```
            417F D0         RET NC              (EXIT IF BREAK PRESSED)
DELAY2      4180 10FE       DJNZ DELAY2
            4182 48         LD C,B
            4183 2B         DEC HL
            4184 7C         LD A,H
            4185 B5         OR L
            4186 20F4       JRNZ DELAY1
            4188 227B40     LD (407B),HL        (ZERO BYTE COUNTER)
            418B 217D40     LD HL,PROGRAM       (START OF PROGRAM)
            418E 223C40     LD (403C),HL
            4191 1E11       LD E,11             (SEND CONTROL Q)
           *4193 CDD840     CALL OUTBYTE
NEWSCREEN   4196 CD2A0A     CALL CLS            (CLEAR SCREEN)
            4199 CD460F     CALL BREAK-1        (CHECK BREAK KEY)
            419C 3026       JRNC EXIT           (EXIT IF PRESSED)
            419E 2A3C40     LD HL,(403C)        (CHECK FOR END OF PROGRAM)
            41A1 ED4B0C40   LD BC,(D-FILE)
            41A5 A7         AND A
            41A6 ED42       SBC HL,BC
            41A8 7C         LD A,H
            41A9 B5         OR L
            41AA 2818       JRZ EXIT
            41AC 2A3C40     LD HL,(403C)
            41AF CD4507     CALL PRLINE         (PRINT NEXT BASIC LINE)
            41B2 2A3C40     LD HL,(403C)
            41B5 23         INC HL
            41B6 23         INC HL
            41B7 4E         LD C,(HL)
            41B8 23         INC HL
            41B9 46         LD B,(HL)
            41BA 23         INC HL
            41BB 09         ADD HL,BC
            41BC 223C40     LD (403C),HL        (STORE ADDRESS OF NEXT LINE)
           *41BF CD0141     CALL OUTSCREEN      (SEND SCREEN)
            41C2 18D2       JR NEWSCREEN
EXIT        41C4 1E03       LD E,03             (SEND CONTROL C)
           *41C6 C3D840     JP OUTBYTE
```

* THESE INSTRUCTIONS REQUIRE OFFSET CALCULATIONS WHEN RELOCATED

CHANGE THE FOLLOWING LINES TO GET STANDARD ASCII OUTPUT FOR OTHER COMPUTERS BY ELIMINATING THE REVERSE AND GRAPHIC CHARACTERS:

```
TABLE       4082 20 20 20 20 20 20 20 20 20 20 22 5C 24 3A 3F
OUTCHAR     4130 E63F       AND 3F
            4132 1833       JR CONT+1
```

From: Charles F. Milazzo, KP4MD

USNS Box 3007

FPO Miami, FL 34051-8150

5 JAN 1986

To: SyncWare News

9016 Flicker Place

Columbia, MD 21045

Attn: Thomas Bent, Editor

Re: Additional Correction to Proof of Article PET ASCII OUTPUT PROGRAM

Dear Mr. Bent:

I have found one additional typographical error in the machine language listing. Please substitute the enclosed page for the last page of the machine language program submitted to you on 26 DEC 1985. The change is at address 418Eh. The original code "22EC40" was in error and has been corrected to "223C40". Thank you for your attention.

Sincerely yours,

Charles F. Milazzo

Charles F. Milazzo